Space Weather Technical Forecast

Issued on Wednesday, 18 May 2022 at 13:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1-R2 radio blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with an M1.0 flare which peaked at 06/1145 UTC by GOES-17 (C9.9 by GOES-16) from AR2014 (Dkc/Beta-Gamma-Delta). This is currently the most notable sunspot group, with recent growth and a small delta area appearing to the north of the leading spot. AR3007 Esi/Beta is another region of note, being moderately sized, and also the only one in the southwest, but is now showing signs of fading slightly. All other regions are relatively simple at this time. A CME was observed in coronagraph imagery, likely from AR3015, and this has been assessed as probably passing behind Earth's orbit. There is low confidence however, and a glancing blow is possible on 20 May. No other Earth directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, shows signs of a high speed stream enhancement. Wind speeds rose from just below 500 km/s, to reach 550-600 km/s. The density has been mainly average or below average. The Interplanetary Magnetic Field, Bt, was mainly weak, but showed moderate peaks up to 11nT between 17/0230-0930 UTC. The north-south component, Bz, mostly varied weakly, but occasionally moderately between +11/-8nT, with a slight positive bias. The phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) has remained mostly at background levels, with the corresponding electron fluence well below the Active (1e8 integrated pfu) threshold on a level trend. Observed fluence at 18/0000 UTC was 1.47e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain at Low to Moderate levels, with an ongoing chance of M-class flares, and a Slight Chance of an X-class flare.

Solar Wind / Geomagnetic Activity: A weak CME was observed which could have originated from AR3015 at 17/0510 UTC. This has been assessed as most likely passing behind Earth's orbit on 20 May, but may give a glancing blow. Confidence is very low, however.

Solar winds are currently elevated with Earth apparently in a high speed stream from a positive polarity coronal hole. It is difficult to be sure of the exact source for this. However, solar winds are likely to be elevated through much of this forecast period, perhaps with a slight dip during Day 1 (18 May) before rising again later Day 1 or early Day 2 (19 May). Geomagnetic activity is expected to be largely Quiet to Unsettled. If we do see a brief dip in wind speeds followed by a further high speed stream, or if we do see the CME on Day 3 (20 May), then Unsettled to Active spells are possible with a slight chance of a G1/Minor Storm interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, but with a very slight chance of flux

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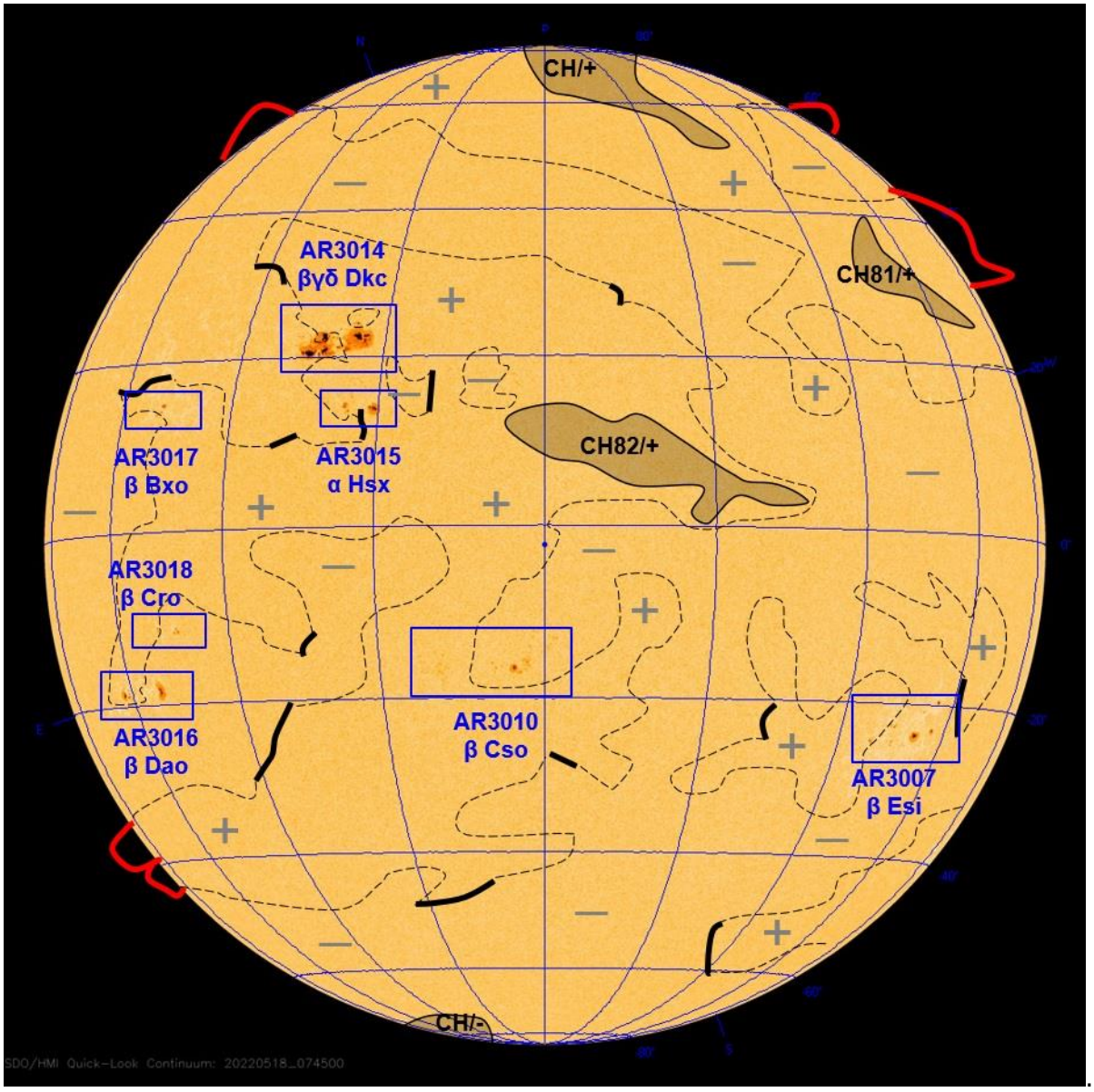
reaching above S1, should any notable flares occur, primarily from AR3007 and AR3014. The high energy electron flux (greater than 2 MeV) is forecast to remain at background levels at first, but may rise over the next few days, with an increased chance of the diurnal peak reaching High levels later in the period due to fast wind effects. The 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold during the forecast period, perhaps on a rising trend.

Figure 1. Solar Analysis Valid 18/0800.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

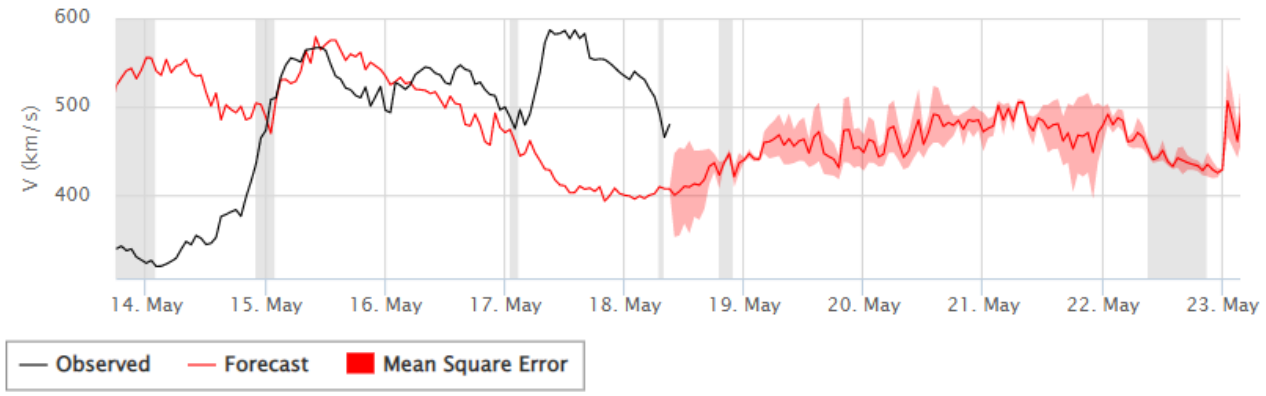
A weak CME observed in coronagraph imagery during 17 May could have originated from AR3015 at 17/0510 UTC. This has been assessed as most likely passing behind Earth's orbit on 20 May, however the assessment of the CME was difficult and confidence is very low. As such, there is just a very slight chance of a glancing blow from this feature on day 3 (20th), and this is unlikely to have a significant influence on the geomagnetic forecast. .

Solar winds have been easing, likely due to the waning influence of coronal hole 81. However CH82 fast wind is expected to soon arrive, leading to slightly elevated to elevated winds persisting through much of the period. This is an equatorial hole, appearing stronger and significantly more westward extended than on the previous rotation, suggesting a more notable enhancement than observed 27 days ago.

Geomagnetic activity is forecast to be largely Quiet to Unsettled with a slight chance of Active intervals. However, this is expected to increase to Unsettled to Active with a slight chance of a G1/Minor Storm interval due to the fast wind arrival of CH82, most likely later day 1 (18th) or early day 2 (19th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	15	15	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Solar Wind Persistence Model



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Radio Blackouts - X-Ray Flares:

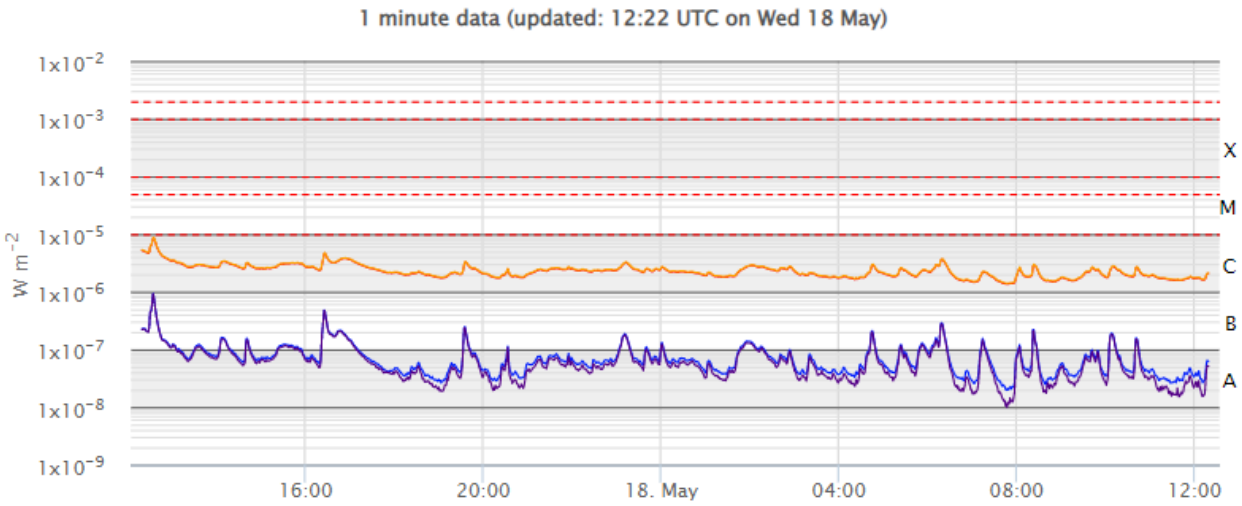
Solar Activity is currently Low with a number of C-class flares observed. M-flares have also been observed on the 16th and 17th.

The most notable region is AR3014 (Dkc/Beta-Gamma-Delta), one of a number of spots in the northeast disc. This region has exhibited notable growth in the last 12-24 hours, with a significant positive delta spot developing north of its negative trailer region and increasing penumbral area. A weak negative spot is also present north of its leader spot, adding to the instability of the region. Given the significant magnetic flux available, M-flares (R1-R2 Radio Blackouts) are considered likely with a chance of X-class flares (R3 Radio Blackouts).

There are seven sunspot regions in total, however all other regions are smaller, and either stable or showing sign of decline. There is also notable looping visible around the northeast and southeast limbs, associated with bright regions visible on STEREO A euvi, and likely indicative of further regions to rotate onto the disc in the coming days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	60	50	40
Very Active	R3 to R5 X Class	No	25	25	20	15

Figure 3: GOES 16/17 X-ray Flux



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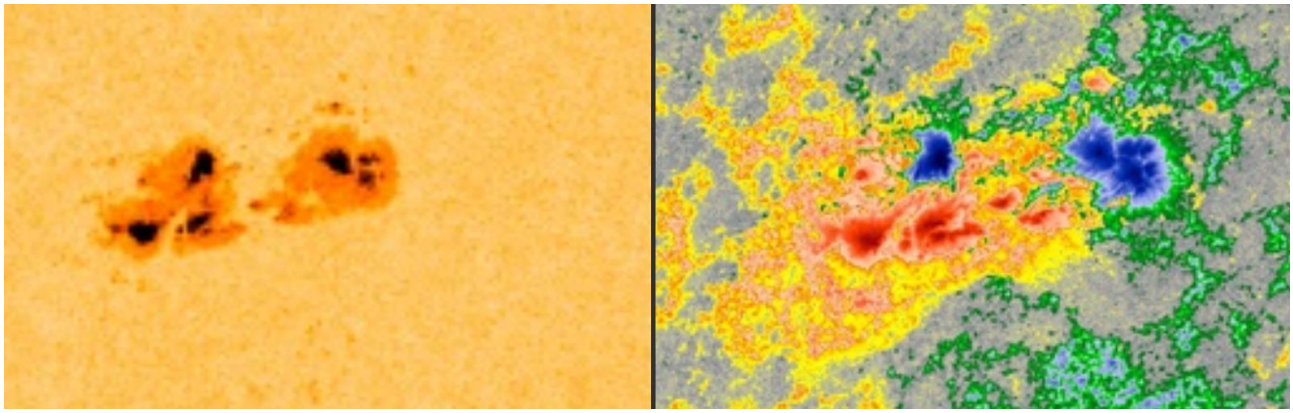
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is expected to remain at that level throughout the period. However, there is a slight chance of an S1 or greater event during the forecast period. This is partly due to AR3007 as it transits towards the western limb of the visible disc., however, the main risk is increasingly from AR3014. This has seen its complexity increase during the last 12 hours, bringing an increased chance of X-class flares.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: AR3014 Intensitygram and Magnetogram



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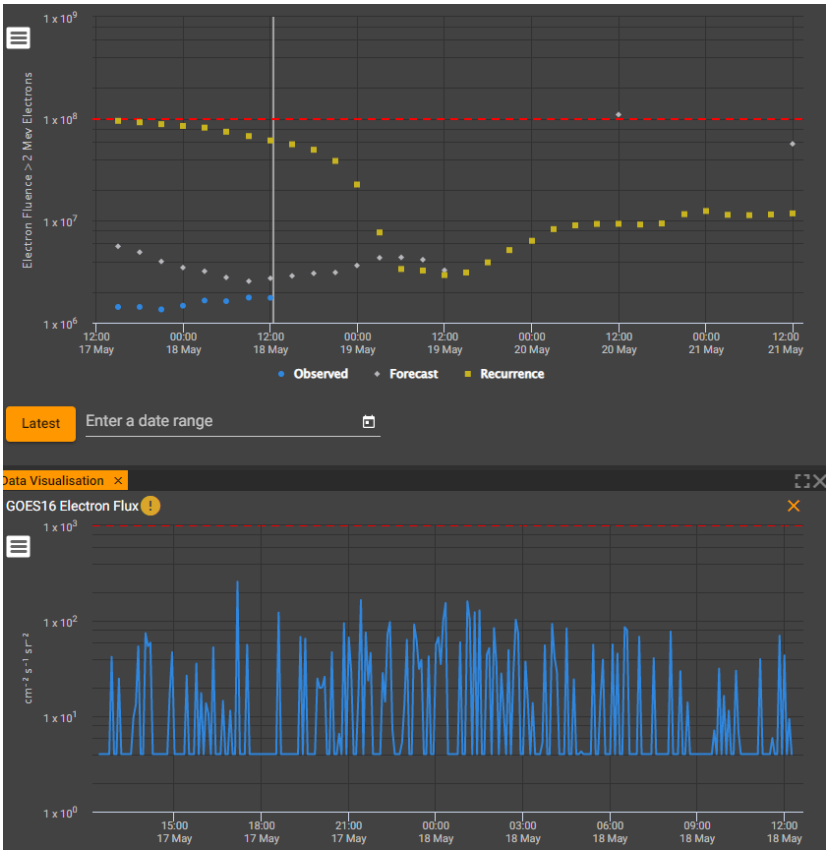
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO is currently at background levels, but may rise to Moderate levels over the next few days due to the fast wind influences from CH81 and CH82. This perhaps giving a chance of flux levels reaching High (1000 pfu) levels later in the period.

The corresponding electron fluence is therefore expected to show an upward trend through the period, however on balance will most likely continue below the Active (1e8 integrated pfu) threshold. This is reflected by current REFM output, although this is currently trending too high on day 2 and 3 (19th and 20th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 >2MeV Electron Fluence (top) and Flux (bottom)



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